ACES FOR INDUSTRY

BY RUFUS STEELE

An absorbing story of a big new idea in American life: the idea that what industry needs is workers with the spirit of the aviation ace, not content to do a routine day's work in routine fashion, but eager to improve in craftsmanship, winning thus richer wage reward and setting new altitude records for the United States in the world's business.

For the manufacturer wrestling with the great problem of production, and for the boy seeking his life work, this book carries a revelation.

INSTINCTS IN INDUSTRY

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BY

RUFUS STEELE

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ACES FOR INDUSTRY

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I

THE war was over—six months over. So far as might be gathered from the dozen men who faced each other alertly across a mahogany table the war was forgotten. Their thoughts were busy with the newer chapter long and loosely heralded as the war after the war. Big men of American industry they were, picking earnestly at a puzzle. There could be no doubt that they had been forewarned, but they were met in frank confession that not one of them was satisfactorily forearmed.

"I'm willing to be pitied," boomed Shetling, "but not to be blamed."

Shetling, on whom the impromptu chairmanship seemed naturally to descend, was a grizzled giant, an animated symbol of the stanch rolling-mill machines that had made his company a reputation round the world.

"We have all been up to the neck in getting out government orders with mighty little time to get ready for to-morrow," he elucidated. "Besides, we did n't know how to get ready."

"You've said it," declared Burford, far down the table — bald, bearded Burford, whose big plant had ceased to spout pleasure cars in order to emit a flood of ambulances and machine guns. "We could n't plan to meet to-day's demands when nobody but an Old Testament prophet could have given us the least idea what the

blue-prints and specifications would be like."

"Well, we've got the order sheet now," snapped Everson, a rubber man, "but I'd hate to think any kind-hearted old prophet ever framed us like this!" When a laugh had subsided he went on: "Demand is colossal. Our own country is short on reserve stocks of every kind. Europe is needing everything we can send to get her back on her feet. Foreign credits are as indefinite as x in algebra. But we can leave payment puzzles to the bankers. How are we going to produce? I want to know. We can't get enough labor, and when we do get it it won't do the work."

"Labor's a jack-in-the-box shot out to the end of its spring!" cried a leather manufacturer. "Labor has got to be sat on until it folds

back into place. Can't go on till then."

"Even then," exclaimed the leather man's nearest neighbor, "we won't have workers enough."

Four men made simultaneous endeavor to add their wisdom to the symposium, but the voice and presence of Rowlands, a king-pin in the hardware world, claimed the attention of the dozen.

"The point is, gentlemen" — Rowlands spoke with judicial deliberation — "we have all the workers we are going to get. American industry has got to do the biggest job in the history of the world with the tools it has in hand. I promised Shetling I'd bring to this informal meeting a man — an engineer who is something besides an engineer — who could tell us how to do the only thing left us — who

could tell us how to sharpen our tools."

"And I told Rowlands I did n't believe his prodigy could shed any real light," boomed Shetling from the end of the table, "but to bring him along. Is your little tool sharpener on tap, Mr. Rowlands?"

The tall hardware manufacturer rose deliberately and left the room. He returned presently, followed by a shorter, stockier man, who carried a roll of charts as though it were a baton and himself as erectly as though he were about to rap an orchestra to attention.

"Gentlemen," Rowlands addressed them, "this is Haliburton. I have told him you are a difficult audience. If you are ready to listen he will tell his own story."

"We welcome Mr. Haliburton," rumbled the impromptu chairman.

"Let him tell it in thirty minutes."

The newcomer laid his charts on the table and stepped behind an unoccupied chair.

"The identity and standing of my hearers are known to me," he began in even tones. "On most subjects it would be far better for me to listen than to talk. If my ideas and proposals appear bold, please remember they have at base some solid concrete of experience."

The speaker was immediately impressive. He was a man well past his youth who retained youth's vigor. He looked through lenses that magnified his comprehending gray eyes. His expression — the precise mustache itself — bespoke practiced powers of evaluation. "Engineer" was written across his face.

"Wars have a way of leaving us in serious industrial difficulties," Haliburton declared as he measured one countenance after another. "The last big one did. Some of you can remember the slump that followed the Civil War. After four years in uniform men seemed to have forgotten most of the cunning with tools that had made them great artisans. Many never returned to the factories at all. Suddenly came an unprecedented demand for shop products, and for a time it seemed that the country must fail to meet its splendid trade opportunity. The call was for highly skilled men, and of skilled men there were not one fourth enough. Since the days of the ancient guilds there had never appeared to be such a lack of workers whose hands and brains were trained by years

of apprenticeship to do exacting mechanical work.

"The situation was met in the only possible way. Invention met it. Machinery came. Machinery leaped into a period of undreamed-of development. The United States manufactured everything required of it because machine tenders could be obtained. Machine tenders, it was held, needed no long or careful training. As machinery reached an ever-higher stage of development, apprentice training, as practiced for a thousand years, went wholly out of fashion. It would never be needed again, men said. Factory workers now had only to pull levers and feed in the raw material. Brains and skill were no longer a necessity. Am I not right, Mr. Shetling?"

"Right enough," agreed the

chairman. "The brains were in the machines."

"The accepted theory." Haliburton thanked him with a nod. "American manufacturers agreed that the machinery possessed about all the brains needed when they beheld output vastly greater and less expensive than it had ever been. Wages went up, but so did profits. Machine production could take care of both. We became a great manufacturing nation. Then the world war! And now the post-war difficulties once more. Destiny is calling us to be industrial world leaders in a way no one could ever have predicted. With sky-high wages and a limited number of workers, how are we to attain unlimited production?"

The speaker paused. Burford gave him an answer.

"I surmise," said the automobile maker, "that you have drawings in the bundle there for some new breed of machinery that can operate itself."

"Alas, no," Haliburton corrected. "A man will have to go on operating the machine, and the machine has about reached the limit of refinement."

"Then I don't see much hope for us," interposed Burford.

"But I do!" cried Haliburton, his face suddenly alight. "I see unlimited hope. That's why I'm here. I see an opportunity we should have noted without a world war to wake us up to it. We've about exhausted the development possibilities of the machine, but we have n't even begun on the development possibilities of the man."

Armchairs grated the table with

the sudden movements of their occupants. Dissent was in the general mumble.

"I'll give you my conclusions first and my premises afterward," Haliburton drove on. "America's industrial man power is the most capable and the least developed in existence.

"The potentially greatest artisan has been lost for a generation and a half because few understood what he could and should be. Now we are going to attend to his development. Refining him will multiply production and be our answer to the world."

"I don't believe it!" boomed the giant at the head of the table. "I don't believe your remedy is any good. Which American worker is going to let you sift your development powder down his obstinate throat?"

"The young one!" shouted Hal-

iburton. "I know what I'm talking about. I'll stick to experience. I'll give you facts and figures. I'll show you how developing the producing agent multiplies the product. I'll tell you about a developing system that shows how the American artisan refines into the wonder-worker of the industrial world. When you see what has been done in one huge plant you must see what might be done in all."

"You've got twenty-five minutes left" — Shetling hunched down comfortably in his chair — "to sell a dozen men who don't believe in miracles."

"I'll try to touch only the high points," Haliburton resumed, "but I wish — I wish I could go into the human side of it so you could see just how we found out the truth for ourselves."

II

In 1902 the Universal plant at Westville, Massachusetts, was turning out some of the highest-priced motors in the market. The price was high because the cost was. The production manager was unhappy. He ranged up and down through the processes of manufacture and tried at every stage to put his finger on the flaw. His success was not notable. Nothing was irregular. All he could do was to curse the luck. He did this with such vigor that the offices heard him and so did the shops. Presently Haliburton heard. Like a man awaiting a signal he headed for the administration building.

"Every machine on motor work turning over regularly," the production manager was explaining to

the general manager, "yet something is lacking."

"Three things lacking," amended the voice of the young man who had entered unannounced.

The officials did not resent the intrusion of Alexander Haliburton. He was an American who had carried off honors in European engineering schools and had then done the more unusual thing of carrying off honors in European plants. Officially he was in charge of drafting and designing. Unofficially he seemed to have an eye for everything between the yard gate and the distant back fence. His suggestions had a way of getting themselves adopted.

"Three things lacking? What are you talking about?" Thus the general manager admitted the newcomer to the discussion.

"Industrial intelligence, skill, and loyalty."

"Interesting if true," commented the G. M. "How can we get them?"

"Only one way to do it," Haliburton assured: "we must breed them in. Let me start my apprentice school to-day."

The production manager scoffed. The G. M. laughed and said: "Same answer as last time. Appropriations for human experiments are still lacking."

Haliburton was not to be thus forestalled.

"I'm ready to go ahead without an appropriation," he announced. "Give me one of those vacant rooms over my drafting department and let me pick ten boys out of the shops."

The G. M. studied his man and evinced the quality of decision that

had made him head of the plant. "Go to it," he said.

Haliburton returned to his own department and walked among a score of men bending over their drafting tables. The sharp features of Charley Trigger were buried in his work and he was chuckling to himself, which meant that a brand-new design of the highest quality was growing under his hand.

"Charley, would you like to help me develop industrial intelligence in a bunch of boys who will some day run this plant?"

The face that Trigger raised radiated a genial magnetism. "What's industrial intelligence?" he queried.

"The mental ability to grasp the whole process while working on any one of its parts."

"Oh, boss! When do we start?"

Haliburton began at the one

point where he could begin without money and without price — at the scrap-heap. Under his direction Trigger and ten eager youngsters whom he had called away from the tool shop and the die shop, dragged out ten discarded machines that were awaiting the junkman and moved them to the room above the drafting department. After much tinkering one old lathe took fresh heart and answered its levers. It was saddled with the job of building the others back to fitness. When the almost miraculous rejuvenation had been accomplished, Haliburton stood once more before the general manager.

"We've got nine lathes, shapers, and grinders and one drill press going," he said. "Give me an order for raw material for all the small pulleys the plant will need in the next six months."

Thus the school began to pay something back from the first day of operation. Two weeks later, the production manager exclaimed to the G. M. in the presence of the school's head: "I'm up against it! Got to have two thousand small steel shafts for motors immediately, and the lathes are too busy to get them out."

"Mine are not," suggested Haliburton.

"Yours?" The production manager fixed him with a puzzled glance. "What do you mean?"

"The apprentice school, of course."

"Don't kid a worried man. Do you think I want all my raw stock ruined and my motors held up by your bunch of kids? Why talk about things that can't be done?"

Haliburton held out appealing

hands to the G. M. The G. M. looked from one man to the other, then gestured with his cigar. The gesture meant that the apprentice school would get its try at the little steel shafts.

"In Heaven's name, Haliburton," cried the outraged production manager, "how are you going to cover me on this?"

"If we fall down," the head of the school promised, "I'll cover you with a silk hat."

Some days ahead of the stipulated time a specimen of shining headgear was purchased — by the production manager for Haliburton's own use. Two thousand little steel shafts, perfect in form and finish, had come out of the rumbling room above the draftsmen and designers. The general manager honored the apprentice school with

his first visit just as the boys were romping out at the close of the day. He had one of the little shafts in his hand.

"I just dropped in," said the G. M., curiously embarrassed, "to ask what were the three things you said we lacked in this plant."

"Industrial intelligence, skill, and loyalty," Haliburton repeated.

"And that is what you and Trigger are doing in your school, is it — teaching these things?" The G. M. did not appear to be following his usual method of directly expressing what was in his thought.

"We are teaching the first two."

"You are n't teaching loyalty then?"

"You can't teach loyalty; you have to inspire it. What was it you really came to talk about?"

"Why — why — hang it all! Aleck, you've shot me full of holes with your little motor shafts, and you know it. They are n't boys' work — at least this plant never saw such work from its boys before. Just what are you up to and just what is it I've got to give you to put it through?"

Haliburton swallowed his excitement and pushed the G. M.'s generous bulk into the only armchair that had found place among the groups of resurrected presses and lathes.

"Apprentice training in this country has been pretty sad business ever since plants got to believing machinery could do the work," he began. "Where they bother at all to put the apprentice tool-maker, pattern-maker, or mechanic through the four years that

make him a member of his craft, it is done about like this: In the first year he sweeps the floor and wipes machines; in the second year he is allowed to run a drilling machine, set up work in the lathe and do a little benchwork; in the third year he gets vise, bench, and floor practice and learns about milling machines, precision measurements, and automatic set-ups; in the fourth year he goes on with these same things and learns to read blueprints and drawings. Then he gets through, and what does he really know? Not very much! He has n't had any proper foundation — has n't learned to think in industrial terms. Why, even most foremen begin to stutter when they see a little bunch of fractions, and most superintendents can't turn out a mechanical drawing any more

than they can turn out an oil painting of Niagara."

"The machinery does most of the thinking," cut in the G. M.

"The biggest lie ever told!" shouted Haliburton. "Iron does n't do any more thinking when it is harnessed and writhing in a machine than when it lay as undiscovered ore in the ground. Is n't the most refined machinery you can think of just a sublime sort of monkey wrench to put into an intelligent hand? Help me train that hand."

"Help how?"

"Help me set up an apprentice course that shall be a trade school and training-room combined, one that shall teach industry's highest principles in industry's very atmosphere. The foremen will tell you most of our boys ran away from

school to get into the plant because school was just drudgery to them. We'll show them a school they'll be crazy to attend. We'll knock the notion that they are simply having knowledge poured in, by paying them as much an hour while they are in the schoolroom as when they are turning out usable pieces in the training shop. We'll give boys the fun of their lives while they are mastering mathematics, physics, technology, and mechanical drawing. We'll put up a job on them. We'll let them believe we are simply turning them into crackajack mechanics, pattern-makers, molders, and instrument makers, with never an inkling that they can hardly avoid becoming masters, foremen, superintendents, and managers. We'll lay the foundation of industrial leader-

ship and give them an outlook, and then let Nature take its course."

Alexander Haliburton was talking the things that had formed in the breast of one with whom industry was the great passion. He looked out the window of the now silent room awhile, then said in a quieter tone:

"We must not go on in this country wasting people. No nation can ever know true greatness until it learns superior conservation of the human factor in production. Let's begin to do something with the most promising raw material in existence — the kind that can think. We've got millions of automatons following along in the worn wasteful ruts; what do you say to developing a few polished producers who may add something to the standards of civilization?"

The G. M. worked himself out of the clutch of his chair. It was a little uncertain whether several staccato squeaks emanated from straining chair rungs or from his own straining throat. When he had got to his feet he said nothing at all. He merely bobbed his head in a way that was plainly and vigorously affirmative, and went out, carrying with him a perfect little steel shaft that would find its place not in a motor but in the treasure drawer of the G. M.'s office safe.

III

SCOTTY, gangling, half-formed, nearing seventeen, came along when the school had been running four years. Haliburton and Charley Trigger, looking through the glass wall of the latter's office, saw the boy swinging up the training-room. Trigger was superintendent of the school now. Haliburton, with vast engineering responsibilities in the expanding plant, found time to drop in every day. The school was still the apple of his eye.

"Small-town boy?" asked Haliburton.

"Yes," Trigger answered. "I give the small-towner the preference because he nearly always makes good, though I don't know why he should."

"I've figured it," said the en-

gineer. "The small-town boy has neither the unconscious inertness of many farm lads nor the over-assurance of the city boy. He realizes that about everything worth while lies outside his town. If he has the strength to turn his back on the clerkship in the village grocery he is good material for us."

Haliburton fell back and watched while Trigger completed the enrollment of Scotty, which had begun by mail. The graduate manager of the training floor was leading the newcomer away when the superintendent recalled him.

"One more question. Do you dance?"

The small-town boy stared at him hard and shook his head.

"Better learn," the superintendent suggested. "It will help you with those legs."

"Gee," cried the boy, "then I'll have to forget my church raising and go to it!"

Scotty found himself on a grinder. Another boy was there to show him how to do simple shaft work — how to grind down straight little parts for a turbine. At the outset the strain was terrible, but after two hours Scotty was able to look up long enough to see that he was far from being alone. More than one hundred boys worked in couples at machines of different kinds. Lordy, what a world! He spat on the floor as an expression of exuberance. The other boy was calling him back to the job, the other boy who handled the little shafts with such bewildering facility. And then Scotty learned that the other fellow had been as ignorant as he three days before. His

spirits rose. Trigger was to dash them.

"Got a parlor in your home?" The superintendent had paused beside him.

"Yes, sir; a daisy."

"Nice carpet and everything?"

"Yes, and a piano."

"Ever spit on that carpet?"

"No, sir; of course not."

"We have n't any carpet here," said the superintendent, "but this big room is our parlor just the same."

Scotty was crushed. Three days later he had revived. He was spending his mornings under a more advanced boy in learning to cut threads, and his afternoons in teaching a brand-new boy to do simple shaft work. He had caught the first great idea of the school. He was boy pupil and boy teacher

too. Everything he was taught he was to make his own by teaching it immediately to somebody else.

Scotty had learned other things besides machine processes in the three days. He had learned that his grammar-school graduation certificate, which he had regarded as meaning much the same as a certificate of vaccination from the family doctor, was his most precious possession. Without it he never could have entered this wonderful world of the apprentice school. He would have to go over a lot of the mathematics he had had, to get a better foundation for more mathematics he had never had. But just the same the apprentice school, with all its patience, had no time to spend on boys who had not finished the grammar grades. In two months he would

begin to spend an hour and a half a day in the classrooms. He even looked forward with eagerness to this, for of course it would not be like school. How could it be when a fellow would get his eighteen cents an hour just the same? In the sudden revolution of his thought Scotty even wished he had a high-school diploma too, for that would let a fellow into the engineering course, and an engineer apparently was the greatest man in the world.

Here was Scotty, least among several hundred boys who knew more than he did, yet with an individuality. He did not guess it; he could not have guessed it; but the circumstances rubbed it in. When he moved along from planer to press, a card bearing his name went with him and slipped into the card

holder on the new machine. More glorious still, Mr. Haliburton himself, on his frequent rounds, stopped and talked with him. By name! This was inexpressibly stimulating to one who had never once seen Haliburton glance toward the name card, who had observed that the great man was nearsighted, and who knew nothing at all of the magnifying powers of a proper lens.

In two weeks Scotty knew what a chuck was; in six weeks he could tell whether a Jacob chuck or an Almond chuck was to be used, and why. Hammer and chisel were once definite terms to him, but not now. Ball peen, cross peen, and straight peen were members of the hammer family of which he spoke with accuracy, and he did not ask for a chisel without specifying whether he

meant cold, diamond point, or cape. And common tools had changed as much in function as in name. He no longer picked them up as crutches, but as means to an end. Then Trigger called Scotty and three other boys who had entered the school on the same day he did into the glass-walled office.

"Go home, you fellows," the superintendent said to two of them. "You mean well, but it is n't in you to handle tools. Be lawyers or something." And to Scotty and the other he said: "You two manage to get by. Here are your apprentice papers ready for signing if you are sure you want to stick for four years."

"How do you know we'll be any good in the classroom?" Scotty asked respectfully.

"Because boys who are good in

the training-room always are," was Trigger's reply.

Scotty set his rambling signature to the document, which specified that he should serve the apprentice school faithfully and that the apprentice school faithfully should serve him.

"You understand this contract to be legally binding on the apprentice, do you?" the superintendent asked.

Scotty drew a solemn breath. "I do," he replied.

"Well, it is not!" denied Trigger. "It would n't hold you ten seconds in any court. We are going to do everything in our power for you not because of any law but solely and simply because we have your word that you will do the right thing."

Thus was Scotty bound. Entirely apart from the fact that

every tentacle of inclination was anchoring his soul to this grand undertaking he knew he would never allow himself to vary one hair's breadth from the pact, for a twenty-million-dollar corporation was banking on his word!

In another month Scotty longed for a few days off so that he might hurry back to Jordan's Corners and halt the outrage being carried on in the grammar school in the name of mathematics. He had tolerated fractions and decimals as taught out there because at that stage of his youth he knew no better; but why in the name of Sam Hill could n't they have let a fellow know what fractions and decimals were really about — how they would help you figure the right size of everything in the world you wanted to make!

And was n't it bully to have school-teachers who could skin out of their coats and do anything in the plant! The classroom work linked to the practice of the training-room had whisked the bushel off the candle of education and sent Scotty's nose into his arithmetic in a way that would have set his mother frantic with alarm. An hour and a half a day he spent in the classroom, and across the back of his arithmetic he glimpsed geometry, trigonometry, and elementary electricity as shining worlds held squarely in the path of his conquering feet.

Trigger came to him in the training-room when he was working a lathe to produce a steel circlet in accordance with a pattern.

"What you making?" the superintendent wanted to know.

"A turbine ring."

"What is a turbine?"

"It's a motor, but I never saw one."

"Like to see one? I just happen to be going over to the turbine shop now."

"Oh, say, Mr. Trigger!"

The superintendent led him down the three flights of stairs, across the yard and into a building a thousand feet long. For an hour — it might have been a year for all Scotty knew — the one inducted the other into the mysteries of big and little steam turbines. They came out with the boy in something of a daze.

"Honest," he asked, "do you think I can ever learn enough to do what those men in there are doing?"

"I would n't dare make a guess." The superintendent rubbed his chin

thoughtfully. "But we'll help you, and you keep on seeing the thing as straight as you can while you study and work."

Haliburton was waiting in the office.

"Been over shooting a little vision into the boy Scotty," the superintendent explained.

"How does he get it, Charley?" asked the engineer with unfeigned solicitude.

"Like a poet. I'm not going to be satisfied with a common crack-ajack out of this piece of material," answered Trigger in unblushing contradiction of his very recent remark to the boy; "I'm looking for a star."

IV

STARS, it appears, must be forged and tempered. There were certain little flaws in Scotty that forced Trigger to burrow persistently into the boy, and sometimes when the superintendent was weary, to doubt for a moment the quality of the material. For one thing, Scotty was slow to see the importance of the thorough mastery of intermediate steps, too eager to see pieces of metal begin to take on the ultimate shape. Trigger got at this by doubling the boy back again and again over things he hated to do. Scotty, mad as hornets, shut his mouth and obediently followed the order. Trigger himself learned several things while machining the bump of overeagerness out of his pupil.

The superintendent was to get his first jolt about the boy near the end of his first year in the school. It was the more unexpected because recent examinations had shown that Scotty's progress was increasingly thorough. Here was his name suddenly appearing four times on the delinquent list for a single week. The list was drawn for purposes of the pay roll from the time clock on which the apprentices registered their coming and going. On Tuesday, said the record, Scotty had not rung in until nearly noon. He had done as badly on Wednesday. There was nothing to show that on the following two days he had returned to the school after the noon recess. The usual footnotes on delinquents recorded the night watchman's statement that the boy had been hanging

round a couple of evenings until put out at ten o'clock.

Trigger was sad. He remembered that Scotty had come to him on Monday when boring holes in the bearing of a grinder and said he needed a reamer so that the holes might be set in with absolute accuracy. The answer given the boy was that a reamer could not be had on account of the cost. It would cost sixty dollars. Had the denial of his request made the boy sullen or reckless? Or what was the explanation of his strange course? The boy must be brought up with a sharp turn and then investigated.

The superintendent was about to go out and set the machinery of discipline in motion when Haliburton came in. He was smiling like a new father.

"Every time I find some real evidence that we are developing initiative on the part of the boys," he exclaimed, "I feel that this school is paying dividends on all the sweat and patience it takes to run it."

"Tell me your good story and I'll tell you my bad one," suggested Trigger.

"I'll try to make you forget yours," Haliburton promised, ignoring the proffered chair. "Coming down the training-room just now I found the boy Scotty working on a job that did not look like anything you would give a first-year man. I asked what he was doing. He said he needed a reamer pretty badly, so he had dug up a chunk of steel and was making one on his own time. My voice seemed to get lost for a minute, but luckily

I found it in time to tell him I had intended adding a new reamer to the equipment and that you would hand him sixty dollars as soon as he had his in operation."

In the classroom course for machinists, tool and die makers, Scotty advanced upon power transmission, chemistry of common metals, and mechanical and free-hand drawing with the same determination that he used in mastering one lathe after another. Every six months his rating raised and his pay per hour increased. The day came when he knew he was no bumpkin any longer; he stood well in the eyes of the other apprentices too; but Trigger felt that the boy was slow to measure himself against the world that lay outside the school. Trigger expressed his feeling to Haliburton, and that in-

genious developer of human material began to plan an experiment of the kind that delighted his soul.

Scotty was encouraged into an extraordinary affection for turbines. He taxed the equipment of the training-room in producing many of the parts. He longed to be shaping the remaining parts and to see all go together in readiness to function. Was it ever possible, he wondered, in a conversation with Trigger, for a fellow to be assigned for a few days to straight work over in that magical zone known as the turbine shop? The kind superintendent agreed to use his influence.

The lad was assigned as helper to Beaney Johnson. Old Beaney knew his business from A to Z. He had been machining steam turbines forever — that was what he

told Scotty. He was glad to get hold of a boy from Haliburton's parlor nursery so he could learn him something practical. Scotty, dumb with admiration and with the thrill of contact with regular production, gazed on the hairy arms of his new master as on the capable shapers of a universe.

They were working on steam-expansion nozzles — cutting expanding holes through a thick circle of steel called the nozzle head. Beaney directed the boy to set up the head in the drill press, and when this had been done with nimble preciseness he ordered:

"Now, kid, stand aside and watch with all the eyes in your head. You'll see the hole come, but whether you see anything more or not all depends. Some boys git onto what's happening and some never

could in a thousand years. Some might even be able to tell all about how it is done but never could learn to tackle the job themselves. Whether you'll ever be able to do it depends on how hard you watch now and how good a man you are when you grow up."

The hole must have a sharp slant. Beaney made a horizontal attack upon the metal, and when the drill had bit in he stopped the machine and reset the drill to the correct slant as nearly as he could figure it, and then starting up once more he drove through the band.

"I guess you saw it all, but it was too deep for you," Beaney said as he examined the hole.

Scotty nodded but said nothing. He was disappointed with himself. He had not expected the thing to

puzzle him, but it did. He swung the nozzle head round for the next hole when Beaney commanded, and watched as before. He was still denied the thrill of comprehension. Beaney seemed to derive a certain pleasure from the boy's continued bewilderment and scolded and twitted him by turns as the morning wore along. At length the perplexity within Scotty articulated itself in a question.

"Mr. Johnson," he asked, "is n't there some way of drilling the slanting hole with a single operation instead of having to stop and reset the drill and make two operations of it?"

Old Beaney let go the drill to look him over with infinite scorn. "What kind of nerve food does this Haliburton feed you up there," he demanded, "that makes you

waste your time wondering if a man who was doing this before you was born knows his trade?"

By mid-afternoon Scotty was in a frame of mind that frightened him. He was still bowing in deference to every act of this old master of the craft, yet some imp rose up within him and kept whispering that the drilling should be simplified by one half and that Johnson's method of figuring the slant was so inaccurate that it was outrageous. He held his tongue in his teeth for hours, but at last the imp managed to jerk it loose.

"Say now," he blurted, "let's figure that slant to a one thousandth of an inch and find a way to drill the hole through at a single clip!"

The old journeyman contracted like a porcupine and then expanded in a shower of vituperative quills

that were intended to perforate his youthful helper past all power to make a further insulting suggestion. But the helper was not perforated. He was merely set to smarting beyond all desire to sleep. He spent half the night at a lathe in the apprentice school beveling little triangular blocks of steel.

When Beaney Johnson ambled into the turbine shop next morning with the deliberate movements of an old grizzly bear Scotty was already present. That was not all. The helper had presumed to set up a nozzle head in the drill press without waiting for the command, and above the place indicated for the first slanting hole he had clamped a beveled steel block, thus presenting a horizontal surface to the drill.

"Throw that fool thing off the

machine!" roared the outraged old machinist, as he looked from the nozzle head to the boy.

"Start the drill; she's all set," said Scotty in reply.

Beaney pushed back his sleeves, crooked his fingers, and advanced threateningly toward his helper. Scotty's face went very white, but he did not offer to throw the piece off the machine and he did not retreat. He picked up a hammer and indicated that he would use it to supplement his physical disadvantage. Beaney hesitated.

"Aw, watch now. Watch just once!" the boy pleaded.

Scotty set the drill to spinning. It bit into the metal. When it should have stopped in order to be given the slant it went on. It was already aslant. The old machinist saw, and his mouth went open like

that of a fish. He forgot everything but the wonder. As for Scotty, he went on drilling away, and the growing hole in the nozzle head was as nothing to a growing hole in his consciousness through which the light of understanding was flooding his soul. More and more clearly an immutable truth stood revealed. Knowledge, he was perceiving, is power.

It was knowledge that had stripped him ribbed and rounded out of the husks of adolescence. It was knowledge that had anchored his feet to the ground when an angry mountain of muscle was advancing upon him. It was knowledge that had enabled an apprentice to make conquest of a veteran of the shops — of an old giant who in all his blustering years had never enjoyed any measure of vision and

accuracy in his undertakings or any measure of assurance in his famished and longing soul.

Scotty, a craftsman among craftsmen, pulled the drill clear of the perfect new hole. There was a moment's pause and then the great hairy arms of Beaney Johnson reached over and swung the steel band round to where another beveled block was clamped in readiness for the second shot. The foreman of turbines, an instructed witness, went skipping to headquarters and reeled off the story.

"It's in him!" squeaked Trigger, wrapping gleeful arms about himself. "I've known it a year!"

"An industrial executive," said Haliburton, "has been born."

While the superintendent and the foreman chattered the man out of whose vision the apprentice

school had come sat looking out the window with unseeing eyes. For the moment he was permitting himself the luxury of dreams. An engineer who could make spiritual appraisals, he surveyed the future, and then and there foresaw things which the inevitable years did bring to pass. He saw this apprentice finishing the machinists' course and eagerly going in for the two years' course that would enable him to set down the things he was thinking with a draftsman's sure line and curve. He saw him rise in a day to foreman of a shop after he had given logical arrangement to the tools of that shop and caused the cost of production to tumble. He saw him while still under thirty as superintendent of a modest plant, a definite and potential figure in industry, superbly justifying

his training, and drawing his five thousand dollars a year.

"I never told you, chief," Trigger broke the reverie, "but once old Scotty confessed to me why he was a week getting here after we had sent word he could have his try at the school. It seems there was a vacant clerkship in the village grocery and Scotty's mother and a couple of long-whiskered uncles came mighty near hanging the lobster sign on him for life."

V

ALL one spring the school was under surveillance by a pair of brown eyes peering out through a dust-covered pane in the foundry. Larry Lukens, the watcher, followed the coming and going of the apprentices with a natural yearning to know what wonders were being unfolded on the top floor of the grim red building to those boys of his own age. Upon the spark of his eagerness husky Dave Womble, with the seasoned wisdom of one who had put in eight years in the foundry, dashed the quenching waters of suspicion.

"You forget those boobs, Larry," Dave would admonish. "They don't even know they're just being hammered by the company into tools to bust the union."

"But listen, Dave," Larry would say, loath to give up his cheerful fancies; "all the wonderful things they are being taught up there, if they can only get over being wrong about the union, ought to make them all-fired good men at their trade."

"Boy, you listen to me," Dave would end and clinch the argument: "I'm a molder and I know. The only thing for a fellow in a plant is to get himself slammed onto the best job possible and then to stay put."

Of course Dave Womble knew. He was more than mentor to the fatherless boy. He could remember when Larry was born in the house next door — he was getting ready to celebrate his own ninth birthday at the time. He had been climbing monkeylike in the steel

frame of the new business block the day Larry's father had lost his footing in reaching too far out for a tossed rivet and had been carried home silent and still. Dave had told Larry he ought not to live off his mother's needle forever, and the day after the boy graduated from the grammar school he had led him to the foundry. A good-natured foreman looking into the frank eager eyes had scrawled the lad's name on the pay roll and told him he was now apprentice and helper to Dave.

Dave Womble worked in sand. While he fingered and considered the wooden pattern, Larry would fetch the two empty frames, which, in spite of appearances, Dave assured him were the cope and bottom of a flask, and Larry would shovel sand into the frames while

Dave poked and jabbed and smashed with his wooden tamper until a firm if brittle mold had formed about the pattern. It was in making the simple cores that the boy's spirits rose. Dave never deigned to lay hand on anything as puny as a core box; thus the job was Larry's own.

"You make good hard cores, kid," Dave complimented him. "You could shoot a hole through a elephant with one and have it still true on the edges. If you quit ruining your eyes rubbering through that dirty window at Haliburton's boobs some day you'll be a molder like me. But remember, sand's your bread and butter now, and you want to cut out the dreaming."

So Larry watched through his clouded pane, envying and pitying

those boys between whom and himself was a great gulf fixed.

"Go up to the pattern room on the top floor of this building," Womble commanded one day, "and ask old Washburn to give you the core box for this new motor head."

The boy climbed the three flights, got what he was sent for and came back to the head of the stairs. He glanced out through an open ventilator, and the core box almost fell out of his grasp. He found himself gazing across a few rods of space into the wide windows of a new world. This world was filled with all the kinds of marvelous machines and big and little tools that one dreamed of sometime or other knowing how to use. But that was not the best part. The new world was peopled entirely by boys — boys of his own age and a

little older — who moved about with joy and airy freedom, making the machines hum and go, and giving no sign whatever that they were being cramped and hammered into tools to bust the union!

Young Christopher Columbus kept his discovery to himself. In the weeks following he told Dave that he had heard this and that of the things that went on in the apprentice school — he was repeating what he had seen through the ventilator in precious stolen moments on the fourth floor — and the husky molder tamped the sand viciously and assured him that one and all these things were lies. Thus the chain by which Dave Womble held the youngster wore thin in one iron link.

One day Charley Trigger, engrossed and detained in laying out

the work for to-morrow, stumbled down the school stairs in the twilight an hour or two after the plant workers had stampeded out the gate. Outside the door a boy lying in wait plucked his sleeve.

"Why is it, please, Mr. Trigger, you use the wonderful school just to train up boys to break the union?"

The lad's voice shook; there was no doubt that he was going straight to the bottom of something that was agitating his soul. Trigger studied his strange questioner hard.

"We don't." The superintendent laid a sure hand on one well-developed young shoulder. "We train up boys and urge them to go into the union. With the knowledge and skill they acquire in the school they can do wonders to make the union strong and helpful and fine."

"Honest to God?"

Trigger rested his other hand on the other shoulder.

"Yes, honest to God," he replied.

"Then, Mr. Trigger, how — how does a boy begin to do something to get in?"

Larry Lukens had completed his enrollment in the apprentice school before he dared breathe a word of it to Dave. Then he got it all out in a sentence:

"I'm in the apprentice school, Dave; going to spend four years there and learn to be a crackajack tool-maker, and then come out to be head of the union or bust."

But Dave could not get it so fast as that, and as the boy gave the news to him in bits he accepted each as a fagot to fire his powder barrel in a fresh place.

"The rotten, lying schemers!"

he exploded. "To think they could slip you out from under my nose and me having never a chance to save you from signing your liberty away! I'll get all the men in the foundry to stand together and we'll make 'em let you go."

"But I don't want them to let me go! Can't you see?" pleaded the boy. "I'm going to stick to the school and the school is going to stick to me, and by and by all of us and you too will be proud because I saw my chance and took it."

"You're a kid. You don't know what you are talking about," the molder declared. "Apprentice schools are just traps of the bosses to make prisoners and slaves of fool boys. I know; I've watched. What 's any workingman got to-day but his right to be free to go on with his work just as his father did and

to tell the rotten scheming bosses to stay where they belong?"

"But, oh, Dave," the helper protested, "what they are going to teach me will do me ten times more good than ever it will them. It's all right. Keep your hands off!"

"And I — and I," stammered the molder, hardly more than a youngster himself, and yet with all the fierce doggedness of one in whom prejudice had obliterated vision — "I have been everything but a father to you. For my sake now, will you tear up those papers and tell them to go to hell?"

The boy shook his head. "You dirty little traitor!" was Dave's good-bye.

Larry Lukens began life anew with the customary lessons on a grinder, and knew that the world was moving when, a few days later,

he was as busily teaching the grinding operation to one far greener than he. He moved from machine to machine, and one night he and his mother went over to call on Dave Womble's mother, so that the apprentice might explain to the incredulous and snorting molder that his soul was still his own and that the school was a mighty funny place; that several hundred boys were busy in it, and yet somehow, so far as he could see, just about everything and everybody there seemed to be for the purpose of helping him to learn.

VI

YET Larry did not always reach out to help himself.

"Lukens," Trigger asked him one day, "why do I have trouble in getting you to use fixtures when they would hold the piece you are working on better than one of these loose sliding jigs?"

"Because I don't like fixtures."

"Lukens," the superintendent whispered, "I'm going to tell you a secret. When I was your age I saw big ugly lobsters for the first time and I said, 'I'll never eat those things.' But I learned to do it, and would you believe it, now I can't ever get enough of them?"

The confidential little story straightened out the boy on fixtures.

Larry had more than a few

weeks of smooth running to his credit, in the classrooms as well as in the training shop, when he was able to pop into the foundry one day while the work was under way. Dave Womble was tamping sand and scolding a youthful helper — the second boy he had had since Larry forsook him.

"Gee, it's nice to see the old sand boxes again," the apprentice said, embarrassed by the silent and motionless attitude the molder assumed as soon as he saw him.

"Has it happened?" Dave demanded.

"Has what happened?"

"Has it happened that you've found out their game and are ready to beg back onto your job with me?"

"Oh, Dave, if you could only understand!" sighed the boy.

The husky molder set a harsh grasp on the apprentice's shoulder. "Kid," he hissed, "I've felt sort of responsible for you since you were born. I keep changing boys on your job here so none can get anchored and so you can come back if you ain't too big a fool, when you do get onto the game that's being run on you. You are mighty lucky to have it this way, but don't you try my patience too long!"

The day came when Trigger asked a group of boys to spend an hour trying to imagine the kind of tool that would set a row of holes uniformly into a piece of metal of given shape and then for each to express his idea in a drawing. That evening Haliburton joined the superintendent and they studied the drawings with an eagerness that would have dumfounded the

crude young draftsmen. The engineer and Trigger loved nothing better than testing for flashes of quality in the human material that was molding in their hands.

"Look, chief," Trigger chuckled, and handed over one of the sheets. "The boy, Lukens, did this. We're building him into a tool-maker, you know."

Haliburton studied the indefinite expression of a perfectly definite idea.

"What we'll get," he predicted, "is a tool designer."

At the end of the first year Dave Womble delivered himself thus to Larry:

"You're lucky, kid, as I've said before; but they'll bust you — just you wait!" At the end of the second year he confided: "They're moving, kid; your big bump is due

pretty soon. I'll tell you how I know they are getting ready to spring things. Yesterday they asked if I would n't like to go on one of those crazy new electric tampers down in the other end of the foundry, and I told them 'Not much!' so quick it made their heads swim. They were thinking of the pay roll of course. I know just where I'm going to hit the roll every week, but those electric-tamper fellers have got to go in and find out."

Larry Lukens was entering his final year when Haliburton observed him watching a new boy induct a newer boy into the use of the grinder. As Larry's eyes took in the boys and their ponderous machine he started suddenly and his mouth opened. Haliburton moved noiselessly to his side.

"What's in your mind, Larry?" earnestly begged the engineer. "Tell me exactly what is in your mind."

"It's funny I never noticed before," replied the boy, "but I was just thinking that grinder is an awfully big and clumsy machine for the simple work it has to do."

Haliburton fairly pounced on his pupil.

"It is!" he exclaimed. "You bet it is! It's a bad machine. A grinder has no right to take up so much room and to require so much gear, now has it? I wish I had time to work out a much better machine. Say, Larry, can't — why can't you work one out yourself?"

Larry Lukens looked hard at Haliburton. Illumination swept the daze out of his eyes.

"I would n't have thought of

tackling such a thing," he answered, "but — but why should n't I have my try?"

In the engineering department of the school were boys whose high-school diplomas had qualified them for that course. Larry had always regarded them with reverence. Now he began to look on one of them with design. A week after he began day-and-night wrestling with his problem he had that embryo engineer eating lunch at his expense. With the pie he unfolded the plan for a new type of machine that had formed in his thought — a plan which needed engineering wisdom in the figuring of proportions and stress.

"Say, boy!" the listener ejaculated. "You've gone and thought something, have n't you?"

A little later the daily lunch-

time conference had enlarged to include an apprentice from the draftsman's course, who drew lines so rapidly under a double flow of inspiration that none of them had time for the trifling item of food.

When his plans and specifications were ready Larry was allowed to gather a construction crew of twenty from among the boys. Skill and enthusiasm for the undertaking were the necessary qualifications. Before manufacture had passed the first stage the entire school was behind the project and the twenty builders found themselves marked and envied men. The various parts seemed almost to leap into existence. When the assembling of them began the school was fairly aquiver. In the midst of the machinery that filled

the great room there grew into being a new grinder, capable, complete, compact, an ingenious simplification of the machine which up to that moment the machinery world had accepted as the best.

A gong sounded at mid-afternoon and two hundred boys laid down their tools, brushed their hair, and assembled about the machine. They were near to bursting with excitement and silence. Superintendent Trigger handed a blank to Larry Lukens and the embarrassed hero set it against the emery wheel and gave his levers a pull. The wail of yielding steel was instantly drowned in a wordless roar. Pandemonium reigned uninterruptedly for half an hour. Since time began a spasm of exultation has seized the human whenever inspiration

has uplifted vision to lay hold upon some eternal how and why. Moreover, it was a boy's triumphant vision this time, and it was boys who were hailing it with maddened tongues.

There is some doubt as to whether Haliburton slept at all that night. He is suspected of having sat until dawn beside the new machine. It was something to be able at last to lay one's hand on concrete confirmation of a gospel one had preached so long. It was something to feel that throughout the years to come there would be found here a fount of assurance for every halting apprentice who took measure of the school — a magic talisman forever whispering that boys who put their hearts into developing their wings might hope to fly among the stars.

Larry Lukens graduated and went hopping up the rungs of the ladder in a branch plant. To-day he is a general manager in a neighboring state. Every year he revisits the school — has his big car swing in off the highway that leads to his summer camp in Maine. He greets Haliburton and Trigger and looks into their understanding eyes. Then he steps across to the foundry to visit one who was once almost a father to him. Dave Womble is still a hard-headed builder in sand. The old friends talk and then the molder follows the other man out to his waiting car. But Dave never sets foot on the running board, never lays a confident hand on the car's glistening door. There is n't a thing in his plant Lawrence W. Lukens would n't give Dave Womble for the asking, and there is n't a thing

in the plant Dave Womble will ever ask him to give. Lukens might force matters, but he knows it would do no good. The reason is psychological. It is geometrical too. A round hole can afford no comfort to a peg or a head that glories in being square.

VII

THE school was a developer of stars; yet stars, Haliburton kept insisting, were the things that interested him least. Real star stuff would move upward naturally; it was the school's business to refine away the clods from prospects who seemed less certain to rise. His passion was turning out stars in the humble magnitudes. Great machinists were as essential as great managers in pointing their fellows the way. He was developing vision and skill to go into the head and chest of the plant, and vision and skill to go into the organs too.

The theory on which Haliburton built up the school was simple and comprehensive. First of all he

recognized the impressive value on raw and plastic human material of utmost neatness, good order, dispatch, and discipline. He knew that atmosphere was a primary element in any scheme of creation. He dwelt on method and process in an effort to cultivate the creative point of view, teaching the use of tools in every detail, but keeping tools in their proper place as means to an end. He kept the apprentice's attention elevated beyond the thing immediately in hand to the point at which results were to be harvested. He sought to inspire the love of difficulty.

Above everything else he wanted to see the youngster breaking original trails while working out his own salvation.

Half a dozen years from the day the school started, the Universal

had begun to feel its influence throughout the plant. Young men by the score and then by the hundred, trained as these had been trained, could not take their places in the shops without their presence becoming felt in an ever-increasing measure. First of all there was an incredible saving on the wear and tear of machines. Then production leaped ahead in the immediate neighborhood of every man from the school. It was the quick response to leadership. There was no more effort than before, just more intelligence. In spots, then throughout the plant, and finally throughout its country-wide business it brought home to the company that the apprentice school was an investment that paid immeasurable dividends.

The flight of the years brought

nothing to suggest any correction in Haliburton's diagnosis of the three things which the plant — and the whole of American industry — needed and must achieve. Industrial intelligence, skill, and loyalty were rock-bottom fundamentals. He developed the first two — and then he challenged the worker who had become truly intelligent and skilled to be disloyal if he could to his boss, to his fellow workers, or to his job!

Four distinct phases made up the school's effort — to train young men for engineering and administrative efficiency and leadership, for semi-professional service, for work demanding specialized mechanical skill, and for all-round manual proficiency. No matter which course an apprentice followed he passed from liability to

asset on the books of the company before he reached his graduation. He might or might not remain with the company after that time.

"Look here!" cried the general manager one day, when the school's graduates had begun to attract the covetous eyes of other employers. "Don't you see that these other plants are stealing our young crackajacks away?"

"Let 'em!" was Haliburton's far-seeing reply. "Please observe that nearly every plant in the country has to have the kinds of goods we manufacture, and if our graduates are working in other plants, which brand of equipment are they going to demand shall be ordered for their use? Why, the brand they have been trained to work with in the school — our brand, that they know all about!"

So it proved. Whether a graduate went into the plant or went to work elsewhere, directly or indirectly he sent coin into the coffers of the company that had trained him.

"I've been looking over the records of the past ten years," Trigger said to his chief one day, "to see what characteristics are common to the boys according to their nationalities."

"What do you find?" Haliburton asked.

"Generally speaking," Trigger answered, "it is about like this: The Jewish boy is a wonder in mathematics. He can calculate anything, but he lacks precision and he lacks originality. With him anything is O.K. if it shines. The German boy is good in mathematics and fairly accurate, but he is slow

and he seldom has any initiative at all. The Irish boy has no great mechanical ability except in rare cases, but he is a great boss — especially when given the driving power over a bunch of his fellow Irish. The Swedish boy has the natural huskiness that makes him a good machine operator, but he won't think things out for himself — not if you will let him follow the leader. The English boy and the Scotch boy make good mechanics because they are resourceful and steady. The American lad is the king-pin. You can drop him out of a window head down and he will land on his feet. He has more than resourcefulness; he has ingenuity. You can flop him into the middle of any problem and he can work out of it if he will. The only thing against our native boy is that he is

too likely to believe the world owes him a living."

Haliburton laughed. "I follow you," he said; "but I accept no limitations on the score of birth. I want to give every boy an opportunity to be better than his kind."

The school came to be copied in other plants of the company and by outside concerns that longed for similar human fruitage of their own. The general manager made no secret of his tremendous pride. He called the school the best of its kind in the country. One day — it was in 1910 — he sat down on Haliburton's desk.

"Aleck," he said, "we owe you something and you are going to get it. I want you to take a couple of months off and go breezing round Europe. Can you guess what I want you to do? They have been in

the business of training apprentices a mighty long time over there, and I want you to absorb any great ideas they have so we can add them to our school. England and France have some schools of their own, but I suppose it is in efficient old Germany that you will find things to make your eyes shine."

In England Haliburton was received with interest. They made him lecture many times on the things they knew his school had done. It was lucky he spoke French, because when he went to Lyons he had countless questions to answer. He went into Germany and for a while he seemed to have been swallowed up.

It was two months later that a bulky form burst into Trigger's glass-walled room.

"Good Lord, what do you think has happened?" cried the G. M., his eyes popping and a letter fluttering in his hand. "Those efficiency sharps are holding Haliburton in Germany until he sets up schools just like this one in three of their biggest plants!"

VIII

"GENTLEMEN, the man problem is the main problem in the United States to-day."

Alexander Haliburton was to have talked to the twelve manufacturers about the mahogany table for thirty minutes, and now they had kept him talking on and on for an even two hours. Haliburton was no orator, but he was an engineer with a knack for rearing imposing structures upon a substantial foundation of facts. The dozen big men were not looking at Haliburton particularly but they were missing nothing of the things he set irresistibly before their kindling eyes.

"Three hundred thousand manufacturing establishments in the

United States," the speaker continued. "This means that the great mass of America's youth is and must be absorbed into our industrial plants. It is the best mind and the best muscle in existence. What are you going to do to fit it to answer the imperative demand of a world?"

There was a sudden shuffling of mahogany chair legs upon the polished floor. Shetling, the impromptu chairman, came stanchly to his feet.

"Mr. Haliburton," he rumbled, "you've shattered all our precious theories with the thunder and lightning of your experience. We have fewer problems than when you began this memorable illumination; but you, sir, have more. I take it that in the next ten minutes you will be called upon to establish

twelve apprentice schools in twelve plants simultaneously, and before very long perhaps much of manufacturing America will have opened its eyes and will be shouting desperately for your help."

THE END

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